Penetrating Injury of the Spinal Cord Treated Surgically

ZHENYU WANG, MM; YI LIU, MD; ZHIGANG QU, MM; JIALI LENG, MM; CHANGFENG FU, MD; GUOMIN LIU, MD

Abstract

A 44-year-old man reported acute neck pain, hyperalgesia, and mild paraplegia caused by a wire-penetrating injury of the neck and was hospitalized. The foreign body was located at the C6 level. Pre- and postoperative physical examination and imaging studies were performed to assess the degree of injury. Emergent surgery was performed 30 minutes after admission to prevent the patient from potential severe neurological impairment and infection.

The patient’s postoperative recovery was significant. Only hyperalgesia at the ulnar side of the forearm remained, with no other positive signs of neurologic loss. Motor strength of the upper and lower extremities returned to normal. The postoperative degree of the spinal cord injury was assessed as American Spinal Injury Association grade E.

Surgical removal of foreign bodies retained in the spinal canal may prevent infection, myelopathy, and delayed neurologic loss. Removal of retained intraspinal metallic fragments can improve neurologic outcome.

Messrs Wang and Qu and Drs Liu (Yi), Fu, and Liu (Guomin) are from the Department of Orthopedics, the Second Hospital of Jilin University, and Mr Leng is from the Department of Orthopedics, the First Hospital of Jilin University, Changchun, Jilin Province, The People’s Republic of China.

Messrs Wang, Qu, and Leng and Drs Liu (Yi), Fu, and Liu (Guomin) have no relevant financial relationships to disclose.

Correspondence should be addressed to: Zhenyu Wang, MM, Department of Orthopedics, the Second Hospital of Jilin University, No. 218 ZiQiang St, NanGuang District, Changchun, Jilin Province, The People’s Republic of China (successwzy@sohu.com).

doi: 10.3928/01477447-20120621-41

Figure: Preoperative lateral cervical radiograph (A) and cervical computed tomography scan (B).
The most common injury site for a stab wound is the thoracic spine, followed by the cervical spine and the lumbar spine.\textsuperscript{1-3} However, penetrating injuries of the cervical spine and spinal cord by metallic fragments are rare. This article describes an unusual case of cervical spinal cord injury with paresis due to a wire penetrating the spinal cord that was treated surgically 12 hours after injury.

**Case Report**

A 44-year-old man reported acute neck pain, hyperalgesia, and mild paraplegia caused by a wire-penetrating injury of the neck and was hospitalized. The foreign body was located at the C6 level. The sharp end of a steel cattle whip broke off due to colliding with a cattle horn during vigorous swinging by the victim. The sharp end fragment penetrated the man’s cervical skin, subcutaneous tissue, musculi platysma, and potential space between the lateral and medial structures, which contain the sternocleidomastoid, carotid sheath, trachea, and esophagus. Then, the foreign body drilled through the prevertebral fascia and the sixth cervical vertebrae into the spinal canal. Finally, the front end of the foreign body almost pierced through the spinal cord to the C6 lamina. Interestingly, the path of the foreign body was similar to that of the standard anterior cervical operative approach. The patient had no severe neurologic loss except hyperalgesia and mild paraplegia.

On admission, a small skin wound 0.8 cm in length was localized at the anterior skin of the neck 5 cm above the right extremitas sternalis claviculae without active bleeding. Hyperalgesia was found at right upper extremity below the elbow joint level and at the right half of the trunk below the xiphoid process level. Neurologic examination indicated that the corresponding sensory level was below C5. Furthermore, muscle strength was tested as grade 4 in the right limbs. The sensation and muscle strength of the left limbs and trunk were spared. Overall, the degree of spinal cord injury was assessed as American Spinal Injury Association (ASIA) grade D.

Routine anteroposterior and lateral radiographs of the cervical spine showed the location of the broken sharp end of the iron wire (Figure 1). Computed tomography scan showed a straight, threadlike metallic foreign body 2.5 cm long in the cervical spine canal located at the C6 level from the right vertebral body portion to the spinous process and left lamina junction. Almost half of it remained in the C6 vertebral body (Figure 2). No bone fragments were found in the spine canal.

Preoperatively, the neck was shaved and prepared, and prophylactic antibiotics were administrated. Emergent surgery was performed 30 minutes after admission to prevent potential severe neurologic impairment and infection. Fiberoptic tracheal intubation was performed with the neck immobilized. All positioning was performed with the patient’s cervical collar in place while the head was maintained manually in a neutral position to avoid motion. Care was taken to avoid lateral rotation or extension, which could have further damaged nerve tracts ipsilaterally or the anterior spinal artery. The cervical collar was removed after all final positioning adjustments were made. The objective level was confirmed again by radiographs.

The lateral anterior approach with a transverse incision of the right wound at the second cervical transverse striation
was used. Blunt dissection was performed after skin and musculi platysma were incised transversely. The anterior border of the sternocleidomastoid muscle was identified, and the superficial layer of the deep cervical fascia was incised. The right carotid pulse was localized by palpation. The middle layer of deep cervical fascia that encloses the omohyoid medial to the carotid sheath was carefully divided. As the sternomastoid and carotid sheath were retracted laterally and the trachea, esophagus, and thyroid were retracted medially, the anterior aspect of the cervical spine was palpated. Blunt dissection was performed on the deep layers of the deep cervical fascia, consisting of the pretracheal and prevertebral fascia overlying the longus colli muscles.

After subperiosteal reflection of the longus colli from the anterior aspect of the spine lateral to the injury level, the resulting exposure was sufficient for identifying the stabbing point of the wire on the C6 vertebra anterior surface. A small portion of the right anterior C6 vertebra was removed carefully by arc osteotome following the traumatic sinus to reach the end of the wire. The wire fragment was easily extracted with no resistance. Subsequently, a small volume of cerebrospinal fluid leaked from the traumatic sinuses. Bone wax was used to make it watertight. The removed portion of the vertebra was regrafted in situ, and the soft tissues were closed.

The patient was kept in a mild Trendelenburg position with a 5° to 10° head-down tilt in bed to prevent cerebrospinal fluid leakage and fistula during the first 3 postoperative days. A hard collar was necessary for 8 to 12 weeks. Early rehabilitation exercises were performed in the bed. The patient was allowed to leave the bed 3 days postoperatively with close monitoring. Five days postoperatively, the patient achieved complete independent ambulation. Physical examination focused on neurological function was performed at 1, 4, and 8 hours and 1, 3, and 7 days postoperatively. The patient’s postoperative recovery was significant. Only hyperalgesia at the ulnar side of the forearm remained, with no other positive signs of neurologic loss. Motor strength of the upper and lower extremities returned to normal. Postoperative general motor function was assessed as ASIA grade E.

Routine postoperative anteroposterior and lateral cervical spine radiographs showed that the foreign body had been completely removed. Magnetic resonance imaging performed on postoperative day 1 (Figure 3) and 1 month postoperatively (Figure 4) showed that no foreign body fragments remained in the cervical spine. Some abnormal frequency signals were present at the C6 level in T2-weighted images. The authors speculate that the signal changes reflected the mild edema of the spinal cord at the injured level. Usually,
this type of signal is not associated with irreversible impairment of the spinal cord. Postoperative treatment consisted of neurological rehabilitation, infection prevention, and other symptomatic treatments, such as fluid replacement, nutrition, and analgesia.

At 26-month follow-up, superficial sensation examination showed that the hyperalgesia at the ulnar side of the patient’s forearm had disappeared. No positive signs of neurologic loss were found, and the patient’s motor function was normal. Standard anteroposterior and lateral cervical spine radiographs showed no abnormalities.

**DISCUSSION**

General and acute imaging studies are indispensable for locating foreign bodies and assessing injuries to the spinal cord. Routine radiographs and computed tomography scans are sufficient for location but cannot show spinal cord damage as well as magnetic resonance imaging. However, MRI can usually only be performed postoperatively because of the ferromagnetic substance of the foreign body. Generally, MRI can reveal a lower signal on T1-weighted images and a higher signal on T2- and proton-weighted images (Figure 3) and an accurate image of any remaining fragments or lesions. Tracheoscopy, esophagoscopy, or contrast radiography of the esophagus (Figure 5) may be used to identify the existence of perivertebral organ lesions according to the patient’s history, symptoms, and signs.

Penetrating injury to the spine is a major cause of spinal cord injury in the United States. Of 6014 cases reported to the National Spinal Cord Injury Data Research Center between 1973 and 1981, approximately 14% were caused by penetrating injuries. Metallic wire-stabbing injuries of the spine and spinal cord are rare, and few have been reported. Most experience with the neurosurgical management of penetrating spinal injuries has been gained during wartime.

During the past half century, the treatment of penetrating injuries of the spine and spinal cord have remained controversial. Clinical experience has shown that some recovery will often occur with no surgical intervention. Lipschitz reported that 14% of patients made a complete recovery and >50% of the patients with incomplete injuries returned to their former employment. This was confirmed by Peacock et al, who reported that 80% of spinal injuries were incomplete and that 66% of patients had a good recovery (walking unassisted). Waters et al reported that 63% of stab wounds to the spine resulted in incomplete neurological injury and that 44% of patients could walk independently at 300-day follow-up.

Studies indicate that surgical removal of foreign bodies retained within the spinal canal may contribute to preventing infection, myelopathy, and delayed neurological loss. Removal of retained intraspinal metallic wire-stabbing fragment can improve neurological outcome. Furthermore, the use of prophylactic antibiotics for 7 to 14 days has been shown to lessen the incidence of infection after a gunshot wound to the spine. The choice of antibiotic agent should be tailored to the entry site, the body cavities transversed, and local bacterial sensitivities. In the current study, cefepime, a fourth-generation cephalosporin antibiotic, was administered to prevent infection. This treatment method proved to be effective for the patient, whose ASIA impairment score improved to grade E, with a significant improvement of hyperalgesia.

**REFERENCES**

7. Takahashi I, Iwasaki Y, Abumiya T, et al. Stab wounds of the spinal cord by a kitchen knife:


